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(71) Applicant  
Zingwe Plant Hire  
Company (Proprietary)  
Limited

769 4th Street

Wynberg

Sandton

Transvaal

Republic of South Africa

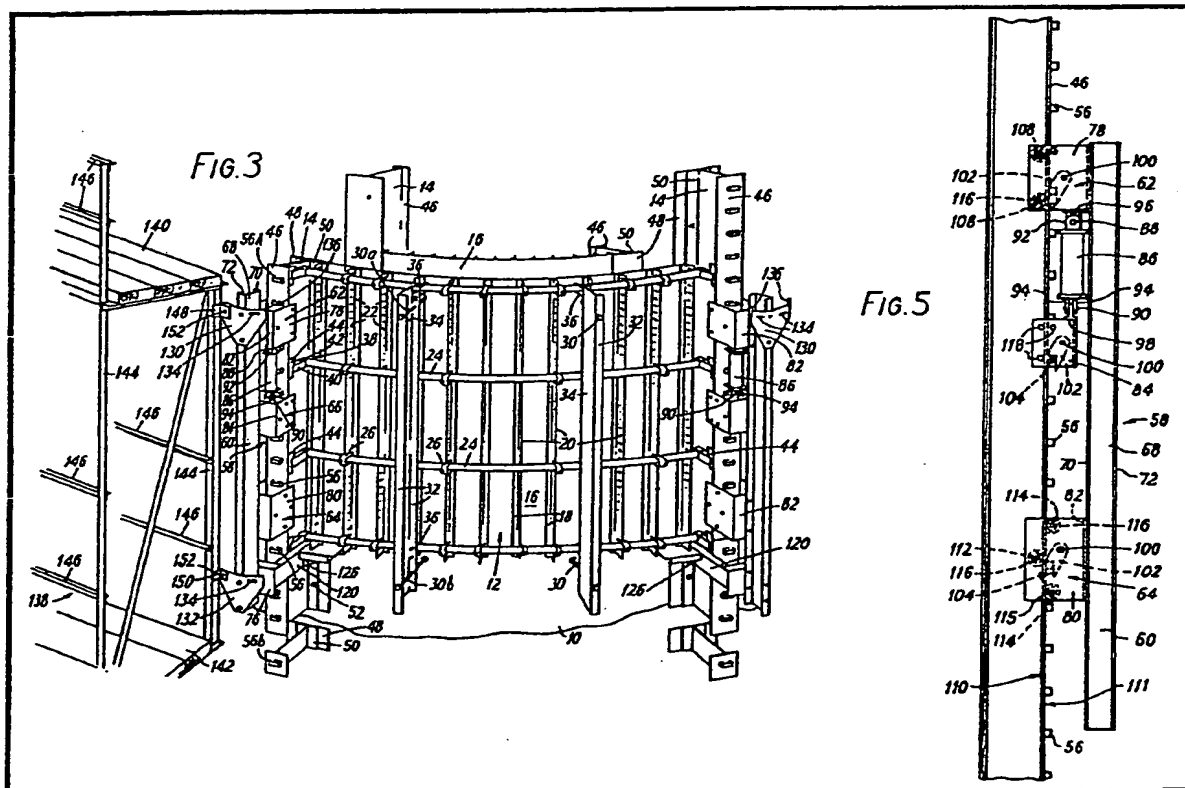
(72) Inventor  
Daniel Jacobs

(74) Agents  
Marks & Clerk

(54) Climbing shuttering

(57) Shuttering 12 is supported for vertical movement by crawlers 58 mounted on soldiers 14. The edges of the shuttering are releasably secured to the soldiers during casting by wedges 44. Each crawler has upper and lower carriages 62, 64 rigidly connected by upright 60 and

an intermediate carriage 66 (84) connected to the upper carriage by a jack 86. Each carriage has a spring-loaded pawl 102 engageable with rack 56 on the soldiers.



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## SPECIFICATION

## Building apparatus

- 5 This invention relates to building apparatus and is concerned with climbing scaffolding assemblies.

10 Climbing scaffolding assemblies are known comprising the combination of shuttering and crawlers. In addition to such shuttering and crawlers there are provided soldiers (also known as reinforcements) which lie in vertical planes for holding the shuttering in place during the pouring of the concrete. The crawl-  
15 ers are adapted to lift the shuttering from one position to the other so that layers of concrete can be laid one above the other to produce the wall being built. Such an assembly is hereinafter referred to as building apparatus of  
20 the kind set forth.

According to one aspect of the invention there is provided building apparatus of the kind set forth wherein the crawlers engage and are adapted to move up the soldiers.

25 Each crawler preferably comprises first and second engagement means adapted to engage the soldiers to prevent movement in one direction but to permit movement in the other direction and mover means for moving the  
30 first engagement means away from the second engagement means in the said one direction and subsequently to move the second engagement means towards the first engagement means also in the said one direction.

35 The engagement means are preferably latch arms or pawls. Such latch arms are preferably spring biased into engagement with projections which are preferably placed on the soldiers to be engaged by such latch arms.

40 Preferably additional latch arms are provided to hold the crawler in position on the soldier when one of the said engagement means, preferably the second said engagement means, is being moved.

45 The mover means preferably, comprises pressure fluid jack means, preferably hydraulic jack means. An embodiment of the invention will now be described by way of example with reference to the accompanying drawings.

50 In the drawings:-

*Figure 1* shows the plan view of an arrangement for casting one wall of a flue for a power station;

*Figure 2* is a section along line 2-2 *Fig. 1*;

55 *Figure 3* is a perspective view of the arrangement of *Figs. 1* and *2* taken in the direction of arrow 3 in *Fig. 1*;

*Figures 4a, 4b and 4c* are respectively schematic drawings showing stages in the  
60 operation of the crawler unit;

*Figure 5* is an enlarged view of a crawler; and

65 *Figure 6* is a perspective view of a detail of the crawler with certain parts shown in broken lines.

Reference is now made to *Figs. 1, 2* and *3* wherein it is shown a part of a wall 10 of the flue. The wall is cast in sections between inner and outer sets of steel shutterings 12  
70 which are held in position by robust vertical reinforcement means or "soldiers" 14. The soldiers 14 comprise "I" section joists. The shuttering 12 comprises face plates 16 reinforced by vertical angle iron strengtheners 18,  
75 the projecting arms 20 of which have slots 22 formed therein at regular intervals. Bearing against the projecting arms 20 of the angle iron members 18 are four equi-spaced pre-radiussed walers 24 which are held in position by "U"-shaped clamps 20 having  
80 hooked arms that engage in the slots 22 in the arms of the strengtheners 18. The shuttering 12 is held at its centre portions by means of ties 28 (*See Figs. 1* and *2*) (conveniently those sold under the trade name "Rawlties")  
85 that are cast into the wall 10 and that receive in their ends bolts 30. These bolts 30 pass through the flanges 32 of intermediate strengtheners or strongbacks 34 and secure  
90 these in position outside the walers 24. "U"-bolts 36 in which are received the walers 24 pass through apertures in the inner flanges 32a of the strongbacks 34 to hold the strongbacks to the walers 24 (as best shown in *Fig.*  
95 *3*).

At each end, each waler 24 has secured thereto an end member 38 comprising a pair of lugs 40 between which is an abutment piece 42. Steel wedges 44 driven between  
100 the outer flanges 46 of the "I"-section soldiers 14 and the abutment pieces 42 of the end members 38 secure the shuttering 12 to the soldiers 14.

The soldiers 14 have overlap plates 48 welded to their inner flanges 50. The face plates 16 of the shutterings 12 lie behind the inner flanges 50. Bolts 52 attached to tie members 54 (also conveniently "Rawlties")  
105 also pass through the flanges 50 to secure the soldiers 14 to the wall 10.

On its outer surface 47, each outer flange 45 of a soldier 14 is provided with spaced square section step members 56. These members 56 are cut from square section steel bar  
115 and are welded at equal distances along the entire length of the flange 46. The end members 56a and 56b are spaced from the ends of soldiers 14 by one half of the distance between adjacent members 50.

120 On each soldier 14 there is provided a crawler 58. Each crawler 58 comprises a spine 60, upper and lower fixed crawler units 62 and 64 and a "floating" intermediate crawler unit 66.

125 The spine 60 comprises a vertical channel section member which has its web 68 arranged radially of the flue and its flanges 70 and 72 parallel to the flanges of the soldier 14. The spine 60 carries at the lower end of  
130 its inside flange 70 a transverse channel iron

member 74 on which is mounted a shutter support 76 (which will be described more fully below).

- The upper and lower crawler units 62 and 64 comprise respectively upper and lower three sided box members 78 and 80. The box members 78 and 80 have their central portions 82 bolted to the inner flange 70 of the spine 60. The intermediate crawler unit 66 also comprises a three sided box member 84.

- The intermediate crawler unit 66 is connected to the upper crawler unit 62 by means of an hydraulic jack 86. This jack 86 is connected at its ends by means of pins 88 and 90 which lie at right angles to each other. These pins 88 and 90 extend respectively between two pairs of lugs 92 and 94 carried by the lower and upper cross pieces 96 and 98 of the upper and intermediate crawler units 62 and 66. All the jacks 86 are connected to a common pump by flexible pipes (not shown) so that all the jacks can be actuated to work as described below simultaneously.

- A transverse pivot pin 100 extends across each box member (78, 80, 84). A latch arm 102 (best shown in Fig. 6) is pivotally mounted on each pivot pin 100, there being reinforcing lugs 103 for the pin 100 on either side of the arm 102. The free end of each latch arm 102 has a right angled recess 104. The shape and size of this recess 104 is such that the latch arm 102 can receive and engage a step member 56 positively.

- A spring 106 is provided to urge each latch arm 102 in a counter clockwise direction (as shown in the drawings) towards the outer surface of the flange 46. It will be seen that as a latch arm 102 passes a bar 56, the spring 106 will permit the arm 102 to swing in an anti-clockwise direction (as shown) to permit the latch arm 102 to pass over this bar 56 but thereafter it will be swung back in a clockwise direction (as shown) towards the outside surface of the soldier 14.

- The upper unit 62 is provided with two pairs of rollers 108 carried by stub shafts respectively at the upper and lower ends of each of the sides of the box member 78. These rollers 108 run along the inside surface 114 of the outer flanges 46 of the adjacent soldier 14 (best seen in Fig. 5).

- The lower crawler unit 64 (which has the box member illustrated in Fig. 6) is also provided with a pair of rollers 112 carried on stub shafts 113 and engaging the inside surface 110 of the flange 46. The lower crawler unit 64 is further provided with two pairs of rollers 114 at its ends engaging the outer surface 111 of the flange 46 of the soldier 14. These rollers 114 are carried on stub shafts 115.

- The rollers 108 to 112 and 114 have enlarged flanges 116 which lie alongside the ends of flanges 46 of the soldier 14 as is

apparent from Fig. 5.

It will be noted that the crawler units 62 and 64 are fixed relative to one another due to their being secured to the spine 60.

- The intermediate crawler unit 66 carries two pairs of stop pins 118 at its ends. These pins 118 lie on either side of the flange 46 of the soldier 14.

- The crawler 58 operates in the following manner from an initial position as shown in Fig. 4a (and Fig. 1) wherein the jack 86 is in its contracted position. In this initial position, the latch arms 102 of the upper and lower crawler units 62 and 64 engage step members 56 respectively. The jack 86 is now expanded. During this expansion movement, the latch arm 102 of the intermediate crawler unit 66 will engage a step member 56 and will act thereagainst to cause the spine 60 and all the parts attached thereto to move in an upward direction away from the step member 56 engaged by the latch arm 102 of intermediate unit 66. The upward movement of the spine 60 will continue until such time as the latch arms 102 of the crawler units 62 and 64 move past the step members 56 above those which they respectively previously engage and the parts take the position shown in Fig. 4b.

- When this occurs, the jack 86 will be contracted. On commencement of such contraction the latch arms 102 of the upper and lower crawler units will engage the respective step members 56 past which they have moved to hold the crawler 58 in position. At the same time the latch arm 102 of the intermediate unit 66 will be moved out of engagement with the step member 56 which it engaged and the box member 84 and with it its latch arm 102 will also be moved in an upward direction.

- This will continue until such time as the latch arm 102 engages the stop member 56 above that which it is shown engaging in Fig. 1. When this has occurred, the entire crawler 58 will be in the position shown in Fig. 4c which is the same position as shown in Fig. 1 save that it will have been raised by a distance equivalent to the distance between a pair of adjacent step members 56 on the soldier 14. It will be understood that the crawler 58 can in this way be moved up any distance desired (being multiples of the distance between members 56.)

- The jacks 86 of the various crawlers 58 are preferably all interconnected so that they operate simultaneously. If desired however the jacks 86 on the outside shuttering may be connected together and those on the inside connected together for simultaneous operation for the purpose which will become apparent below.

- The transverse channel iron member 74 faces the shuttering 12 and carries on either side of the soldier 14 a robust section mem-

ber 120. Projecting outwardly from the inner ends of the member 120 are bracket plates 122 having supporting and reinforcing pre-shaped angle iron members 124 as well as a gusset plate 126. The bracket 122 extends close to the wall surface 16 and under the ends of the shuttering 12. When the crawlers 58 are moved upwardly as described above, the brackets 122 will engage the ends of the shuttering to lift it up together with the crawlers 58.

Bolted to the upper and lower ends of the outer flanges 72 of the spine 68 of the outer crawlers 58 are respectively inverted substantially triangular carrier brackets 130 and 132. Near the upper corners of each bracket 130 or 132 is an elongated slot 134 and a locating pin 136 is welded to the side of the bracket. A working platform cradle 138 comprising upper and lower timbered working platforms 140 and 142 respectively, vertical carrier members 144 and guard rails 146 is carried between each adjacent pair of spines. The cradle 138 is connected to the brackets 130 and 132 by means of angle iron connectors 148 and 150 respectively, through which pass bolts 152 that extend through the slots 134. An inverted "J" plate 154 is located between connector 148 and bracket 130.

The spine 60 of each inner crawler 58 has a bracket 156 secured to the upper end of the web 68. An inner cradle 158 comprising fabricated angle iron trusses 159 radiating from a pair of channel-section radial centre posts 160 is connected to the bracket 156 through a sliding joint 162. This cradle 158 carries an internal timbered platform 164.

"U" members 166 are welded to the lower ends of webs 68 of spines 60 to carry suspended working and access platforms or bosun's chairs.

The apparatus operates as follows after a portion of the wall has set. The bolts 30 are disconnected from the ties 28. The shuttering 12 is now free to move relative to the wall 10. The steel wedges 44 are hammered out and removed. The shuttering 12 is now free to move relative to the soldiers 14. The crawlers 60 are now moved upwardly as described above in a number of steps. The shutter support brackets 126 engage the lower edge of the shuttering 12 and lift the shuttering. The usual height of the lift is just under the height of the shuttering 12 and one half of the height of a soldier 14.

New ties 28 are now located in position between upper bolts 30a, while the lower bolts 30b engage in ties 28 previously engaged by the upper bolts 30a. The wedges 44 are now hammered home. The next section of the wall 10 can now be cast.

It will be seen that the crawlers 60 move up the soldiers 14 and, save for the tie members 58, are in no way connected to the wall 10.

It will also be appreciated that once a crawler 60 moves to the top of one of the soldiers 14, the next soldier can be placed in position between the arms of the upper box member 62. This will assist in the plumbing of the soldiers. For ease of operation the soldiers are preferably located in a staggered relationship.

Because the upper and lower bars 56a and 56b are spaced from the ends of the soldiers by one half the distance between the other members 56, the step from member 56a to a member 56b of a soldier thereabove is the same as a step between two such members 56.

It will also be appreciated that the scaffolding cradles etc attached to the crawlers 60 can be varied as desired for each particular operation. Further, by varying the length of the ties and the dimensions of the shuttering 12, the arrangement as above described may be used for casting walls of varying thickness and shape e.g. flues and/or walls for cooling towers or the like or plain straight walls.

The invention is not limited to the precise constructional details hereinbefore described and illustrated in the drawings. For example the shuttering 12 may comprise timber or other suitable material as may the wedge. The step members 56 may be of other shapes e.g. they may be cut from round bar. Other working platform arrangements may be provided.

#### CLAIMS

1. Building apparatus comprising shuttering between which a portion of a wall can be cast, vertical reinforcements separate from the shuttering and against which the shuttering can be secured, and crawlers for lifting the shuttering relative to the reinforcements, characterised in that the crawlers respectively engage and move up the reinforcements to lift the shuttering as aforesaid.

2. Apparatus as claimed in claim 1 wherein in each crawler comprises first and second engagement means adapted to engage the reinforcements to prevent movement of the crawlers relative thereto in one direction but to permit movement in the other direction.

3. Apparatus as claimed in claim 2 characterised by mover means operatively connected to the first and second engagement means and being operable to move the first engagement means away from the second engagement means in the one direction and subsequently to move the second engagement means towards the first engagement means in the said one direction.

4. Apparatus as claimed in claim 2 or 3 characterised in that the engagement means comprise latch arms.

5. Apparatus as claimed in claim 2, 3 or 4 characterised by projections on the reinforcements adapted to be engaged by said engagement means.

6. Apparatus as claimed in claim 5 characterised by spring biasing means operatively connected to the latch arms to spring bias said latch arms into engagement with the

projections.

7. Apparatus as claimed in any one of claims 2 to 6 further comprising additional engagement means to hold the crawler in position on the vertical reinforcement when one of the engagements means is being moved.

8. Apparatus as claimed in claim 7 wherein the additional engagement means hold the crawler in position on the vertical reinforcement when the second said engagement means is being moved.

9. Apparatus as claimed in claim 3 or any claim dependant thereon characterised in that the mover means comprises pressure fluid jack means.

10. Apparatus as claimed in claim 9 characterised in that the pressure fluid jack means comprises hydraulic jack means.

11. Apparatus as claimed in any one of the preceding claims further comprising retainer means which when operative operatively connects the shuttering to the reinforcing means.

12. Apparatus as claimed in claim 11 wherein the vertical reinforcement means include abutment surfaces against which the retainer means may abut onto the shuttering in position relative to the reinforcing means.

13. Apparatus as claimed in claim 11 or 12 characterised in that the retainer comprise wedges or the like.

14. A method of building, comprising securing upright reinforcement to a wall, supporting shuttering by means of the reinforcements, pouring settable material into the space between the shuttering and after this settable material has at least partially set, lifting the shuttering by means of crawlers to an upper position ready to receive further settable material characterised in that the crawlers engage the reinforcements and move up the reinforcements to lift the shuttering.

15. A method is claimed in claim 14 characterised in that the shuttering is secured to the reinforcements during pouring.

16. A method is claimed in claim 14 or 15 in which the crawler comprises first and second engagement means operative to engage the reinforcements characterised by engaging the reinforcement by the second engagement means, moving the first engagement means upwardly relative to the second engagement means, causing the first engagement means to engage the reinforcement and then lifting the second engagement means and moving it towards the first engagements means and then causing it to engage the reinforcement.

17. A method is claimed in claims 14, 15 or 16 comprising lifting of the shuttering by

an amount approximately equal to one half of the length of the reinforcements.

18. Building apparatus for use in in situ casting of a wall comprising

(a) shuttering members

(b) vertical reinforcements having outer surfaces lying substantially parallel to the wall surface,

(c) horizontally extending projections on

the said outer surfaces of the reinforcements,

(d) securing means temporarily securing the reinforcements to a part of the wall which has already been cast,

(e) wedge means which when operative temporarily secure the shuttering members to the reinforcements and which when operative permit relative movement between the shuttering members and the vertical reinforcements, and

(f) crawler means respectively on the reinforcements having:-

(i) first and second engagement means to engage the said projections in such a way as to permit movement in one direction along the reinforcement but not in the reverse direction,

(ii) hydraulic jack means for moving the first engagement means away from the second engagement means in the said one direction and then moving the second engagement means towards the first engagements means in the aforesaid direction so that on completion of such movements, the crawler will have moved up the reinforcement and

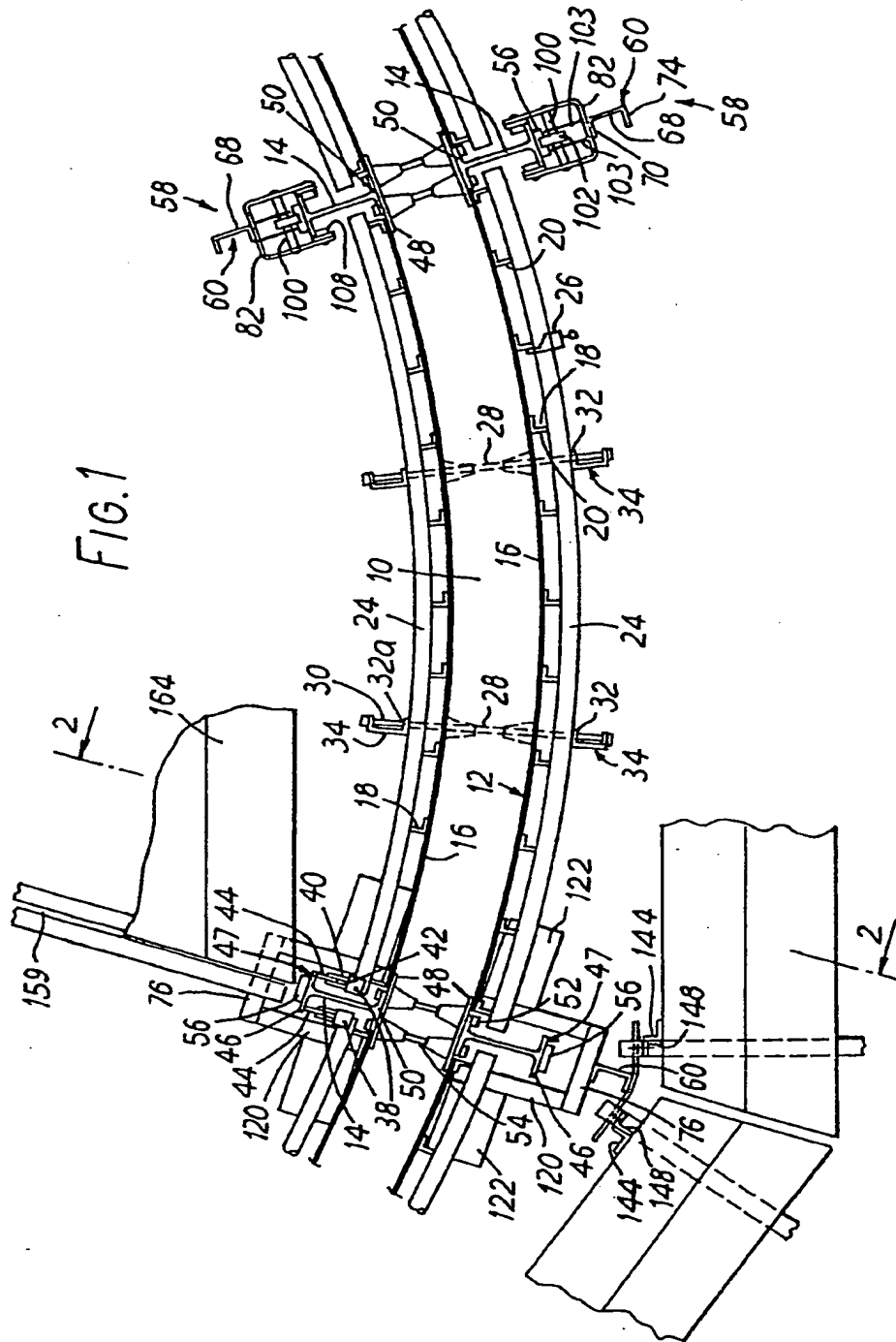
(iii) lifting means engaging the shuttering so that on upward movement of the crawler up the reinforcement the crawler lifts the shuttering relative to the reinforcement.

19. Building apparatus substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

20. A method of building substantially as hereinbefore described with reference to the drawings.

21. A construction built using the apparatus claimed in any one of claims 1 to 13 and 18 and 19 or by a method as claimed in any one of claims 14 to 17 and 20.

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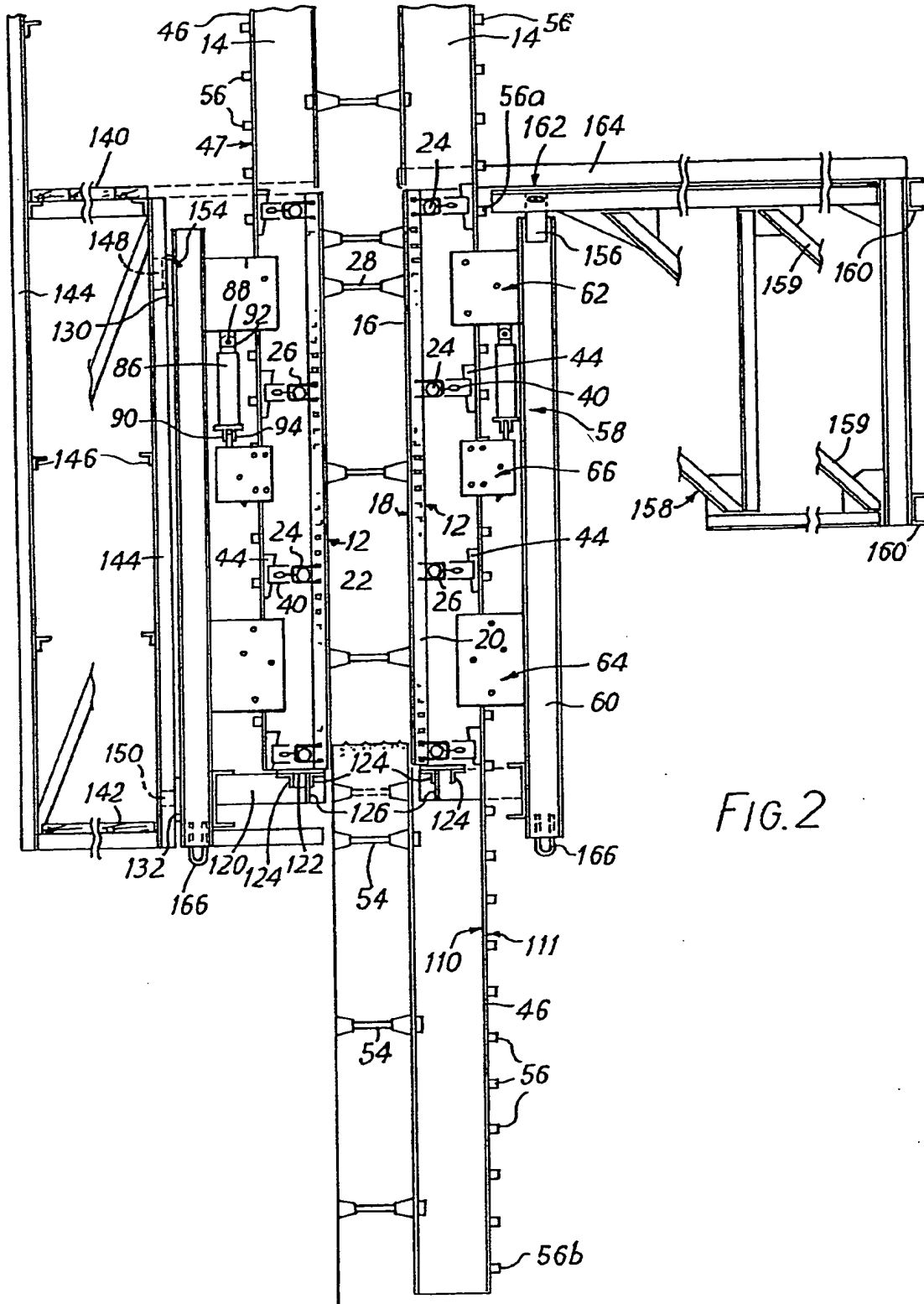


FIG. 2

FIG. 4a

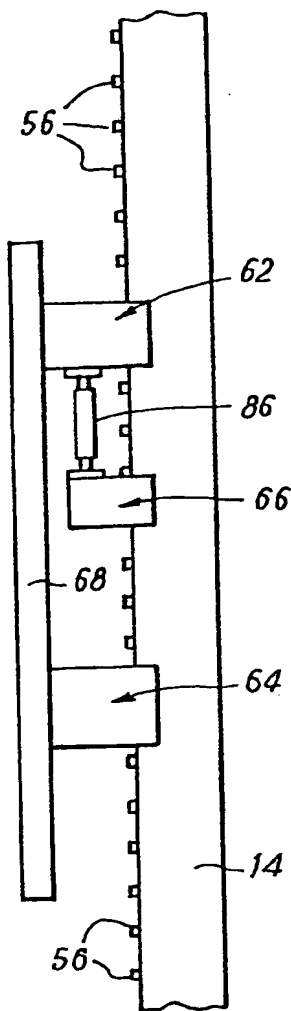


FIG. 4b

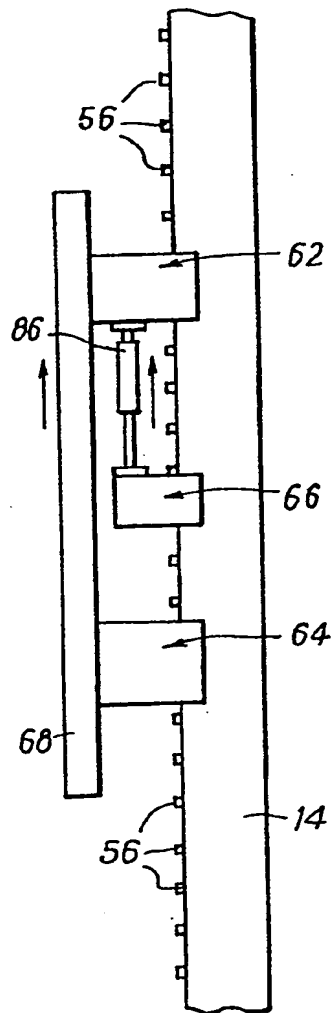
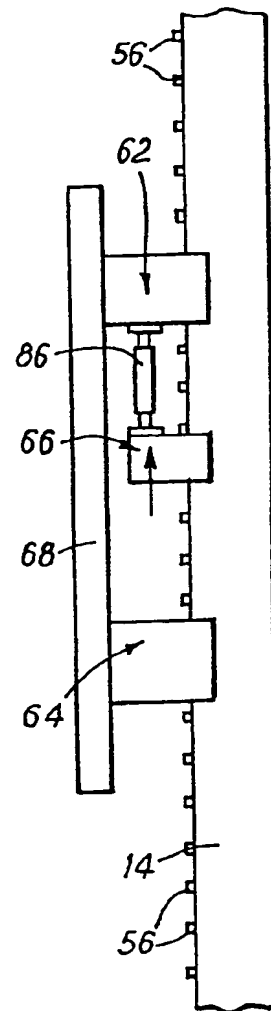


FIG. 4c





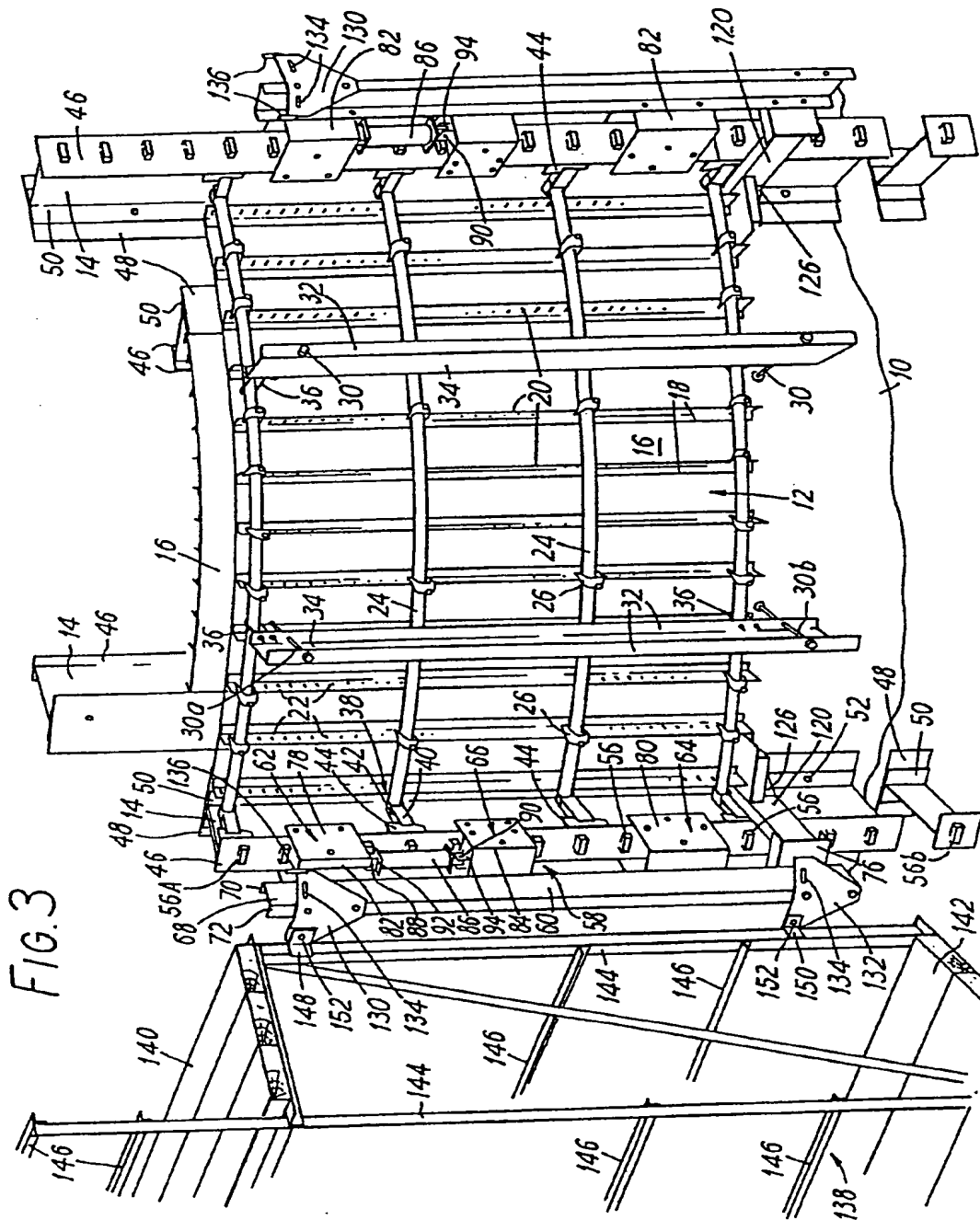


FIG. 5

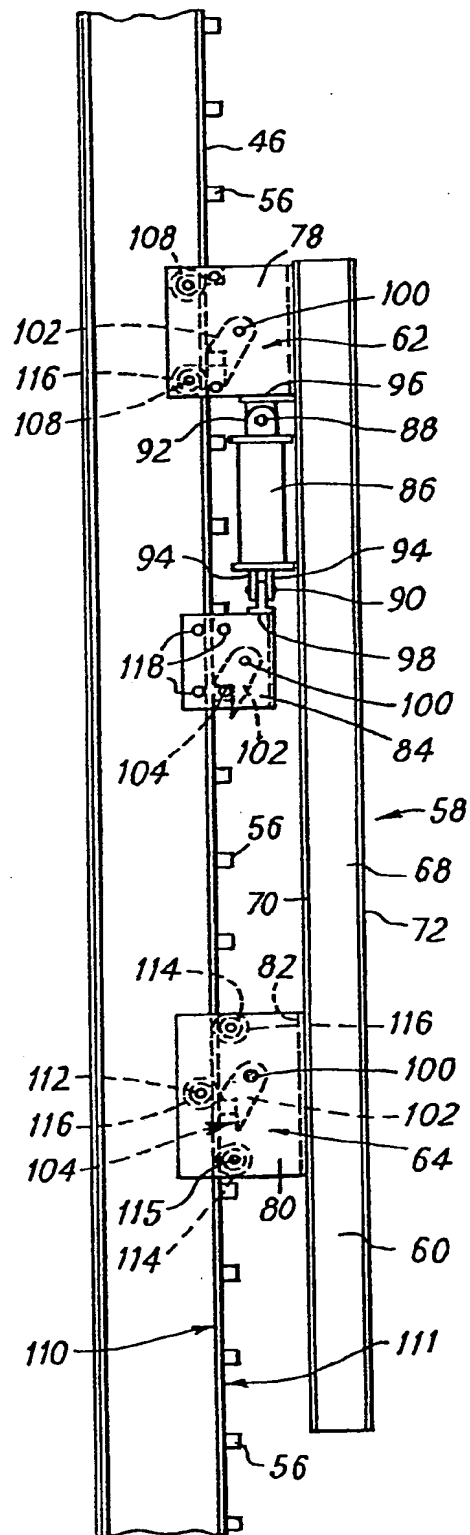


FIG. 6

